Renal Physiology Lect-3
Guyton chapter 28

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Objectives

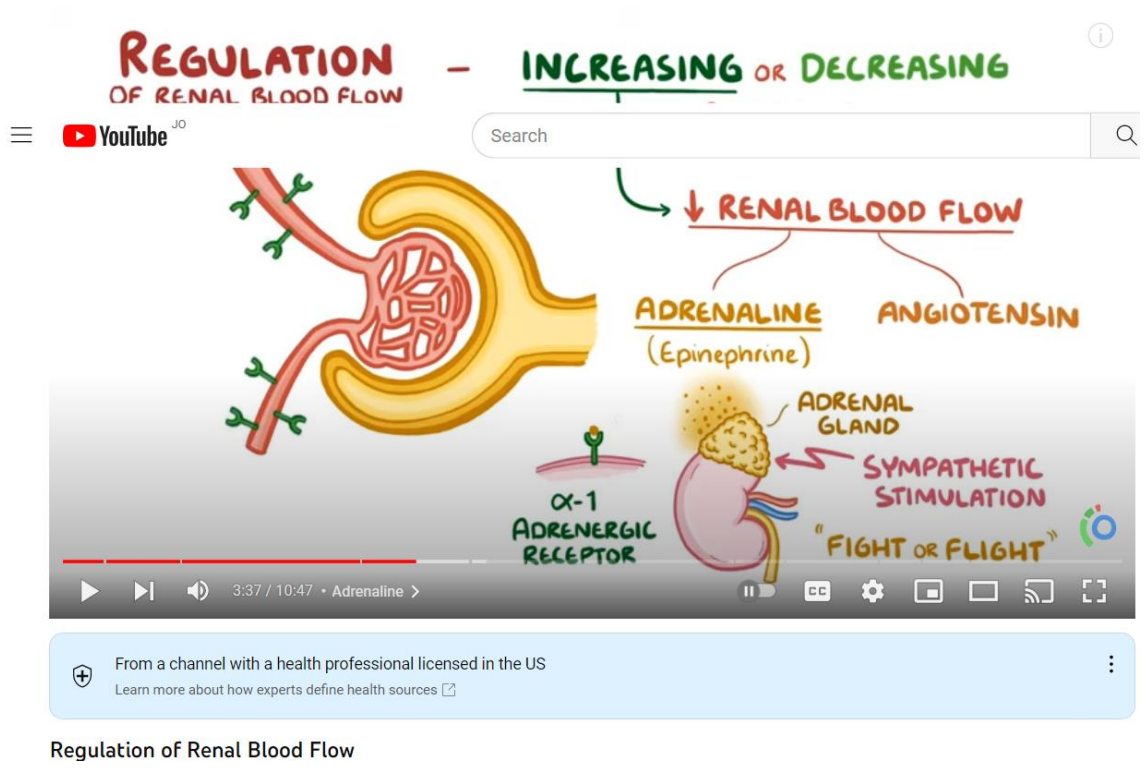
- Identify control mechanisms of Glomerular Filtration and Renal Blood.
- Describe the hemodynamic forces that govern filtration function and control mechanisms of GFR and RBF
- Understand the importance of renal autoregulation

Control of GFR and renal blood flow

- Neurohumoral
- Local (Intrinsic)

Audio-visual Aid

[Regulation of Renal Blood Flow - YouTube]



Control of GFR and renal blood flow

1. Sympathetic Nervous System /catecholamines

$\uparrow\uparrow R_A + \uparrow R_E \longrightarrow \downarrow GFR + \downarrow\downarrow RBF$

e.g. severe hemorrhage

2. Angiotensin II

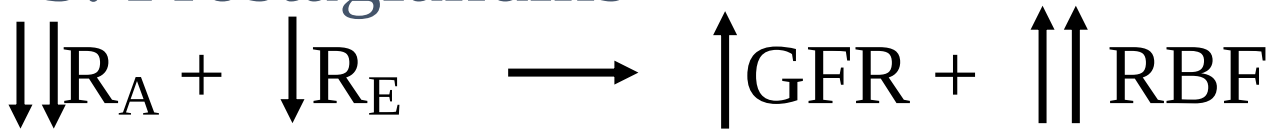
$\uparrow R_E \longrightarrow \longleftrightarrow GFR + \downarrow RBF$

(prevents a decrease in GFR)

e.g. low sodium diet, volume depletion

Control of GFR and renal blood flow

3. Prostaglandins

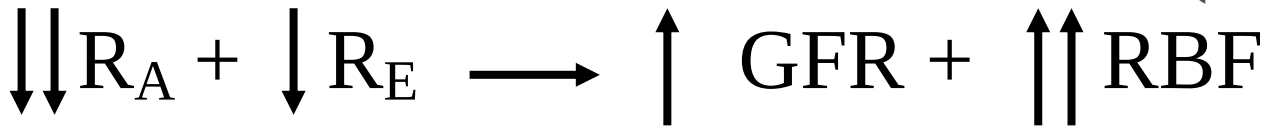


Blockade of prostaglandin synthesis → ↓ GFR

- This is usually important only when there are other disturbances that are already tending to lower GFR

- e.g. nonsteroidal antiinflammatory drugs in a
- volume depleted patient, or a patient with heart failure,
- cirrhosis, etc

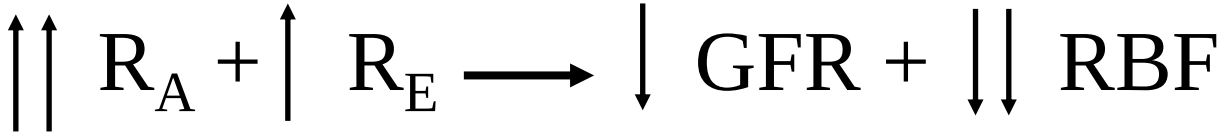
4. Endothelial-Derived Nitric Oxide (EDRF)



- Protects against excessive vasoconstriction
- Patients with endothelial dysfunction (e.g. atherosclerosis) may have greater risk for excessive decrease in GFR in response to stimuli such as volume depletion

Control of GFR and renal blood flow

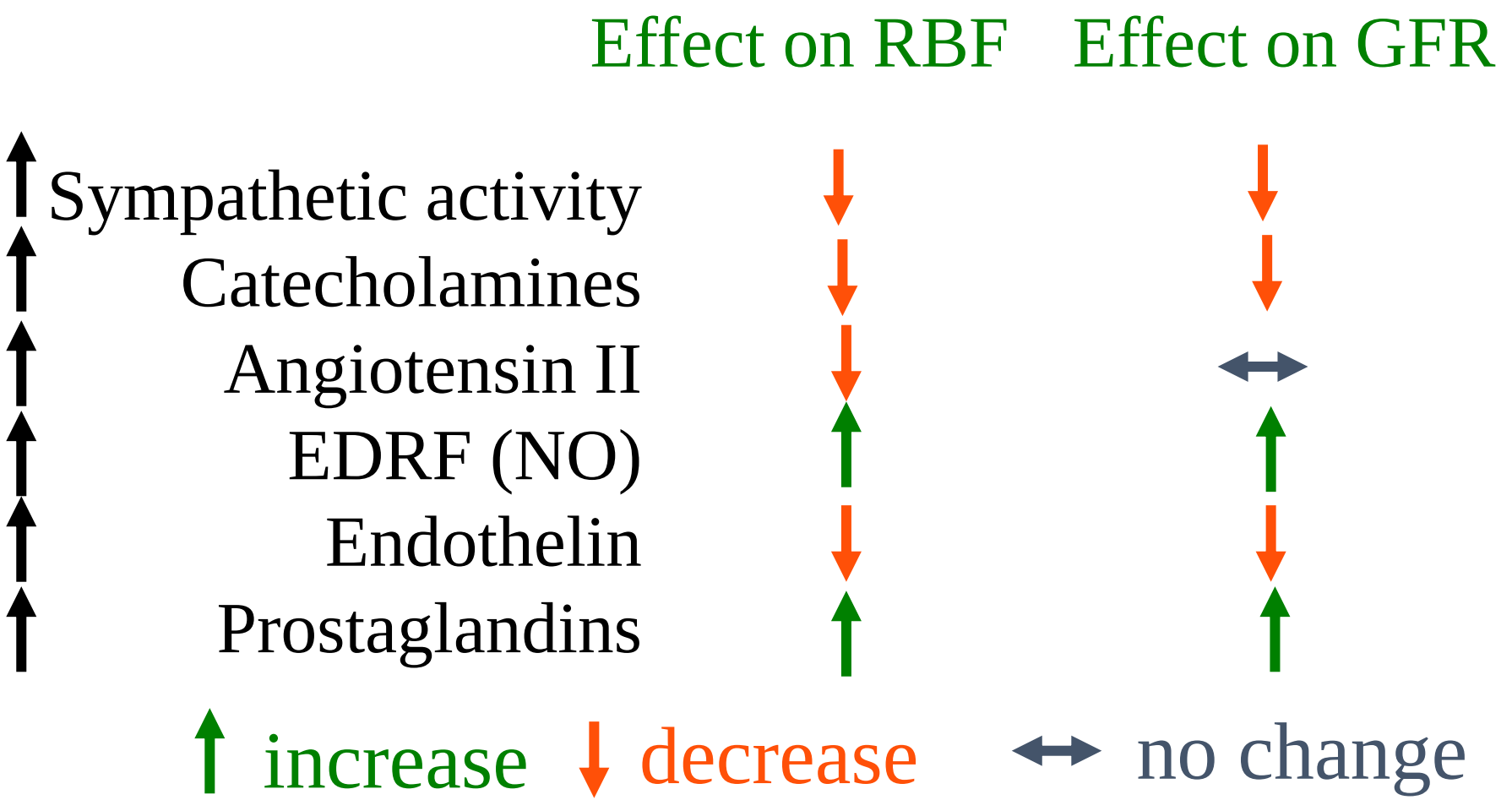
5. Endothelin



- Hepatorenal syndrome – decreased renal function in cirrhosis or liver disease?
- Acute renal failure (e.g. contrast media nephropathy)?
- Hypertensive patients with chronic renal failure?

Endothelin antagonists may be useful in these conditions

Summary of neurohumoral control of GFR and renal blood flow



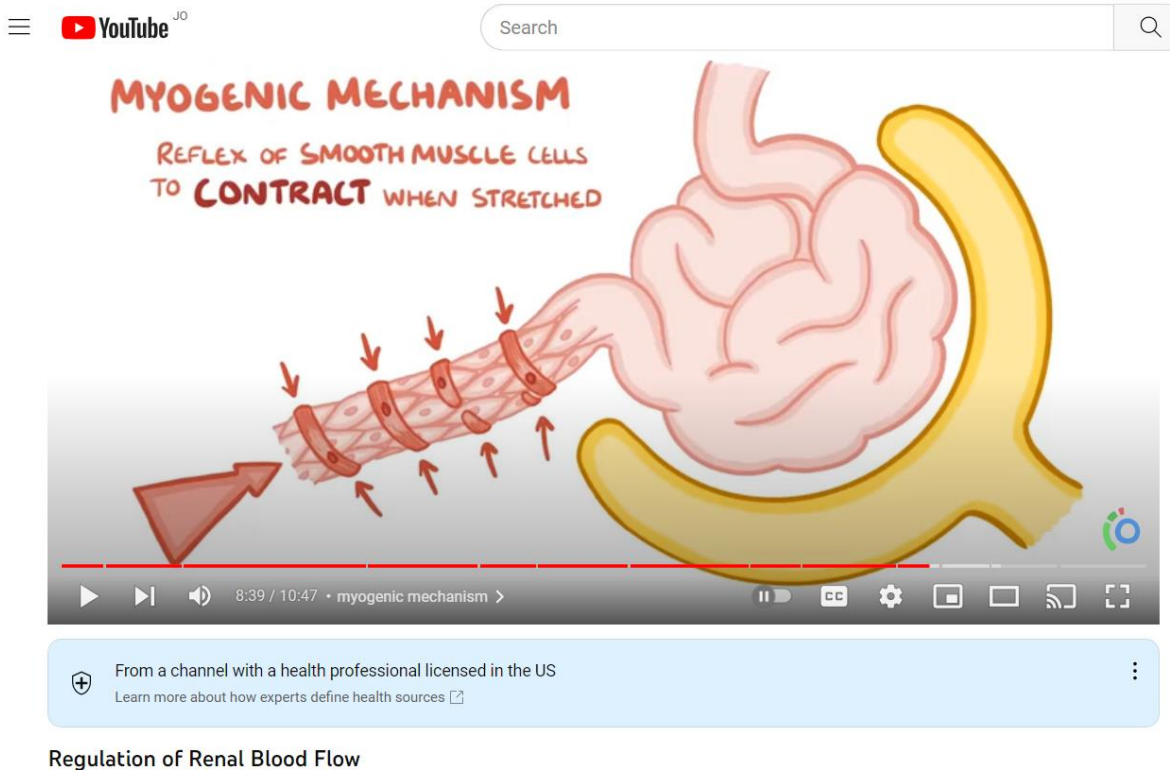
Local Control of GFR and renal blood flow

7. Autoregulation of GFR and Renal Blood Flow

- Myogenic Mechanism
- Macula Densa Feedback (tubuloglomerular feedback)
- Angiotensin II (contributes to GFR but not RBF autoregulation)

Audio-visual Aid

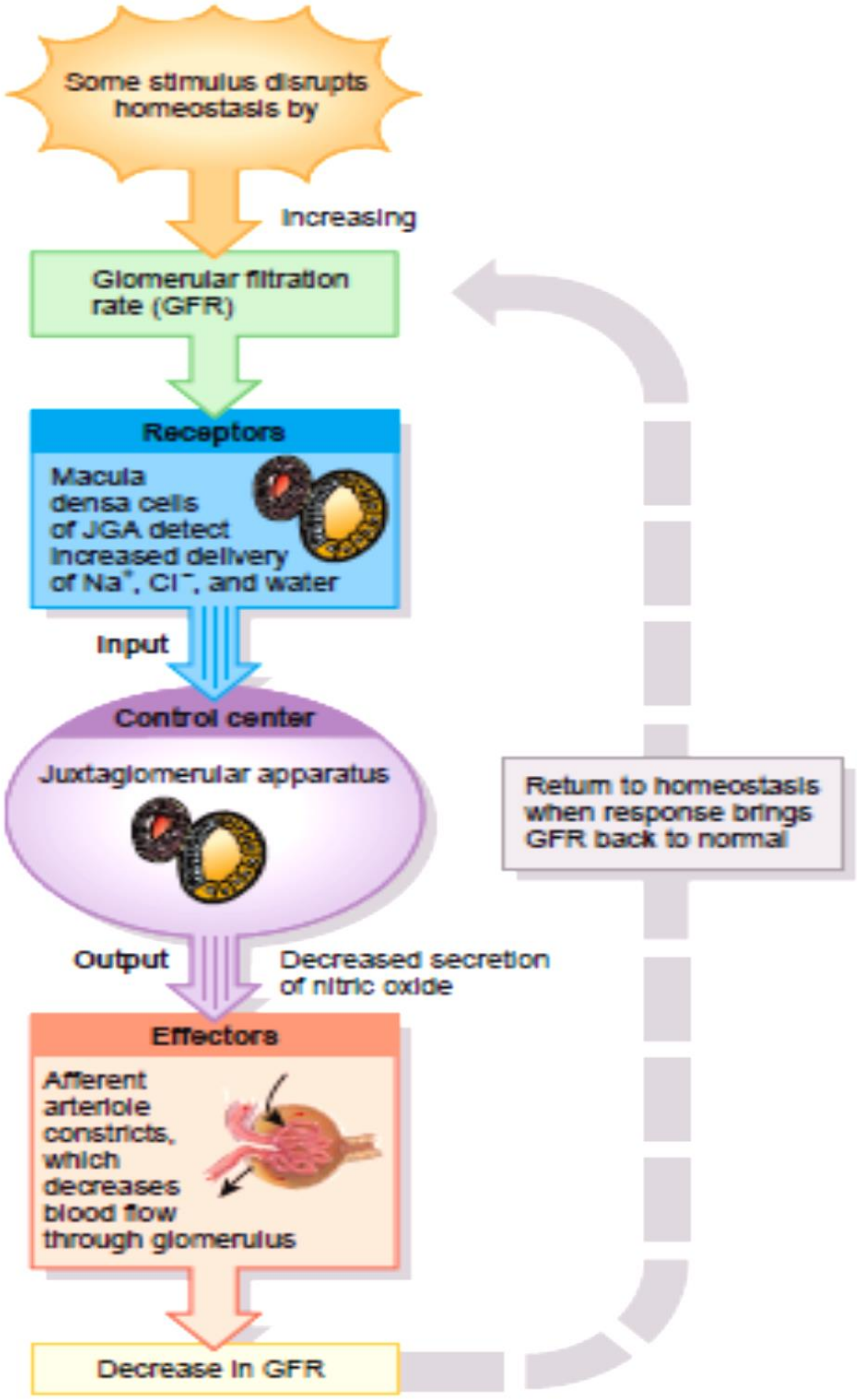
[Regulation of Renal Blood Flow - YouTube]



Renal Autoregulation of GFR

2. Tubuloglomerular feed back mechanism:

- Feedback loop consists of a flow rate (increased NaCl in filtrate) sensing mechanism in macula densa of juxtaglomerular apparatus (JGA)
- Increased GFR (& RBF) inhibits release of the vasodilator ; Nitric Oxide (NO)
- Ang II when blood pressure falls is released increasing systemic BP and increasing glomerular hydrostatic pressure and thus GFR, however, when blood pressure is increased renin and AngII release are inhibited



Renin secretion regulation

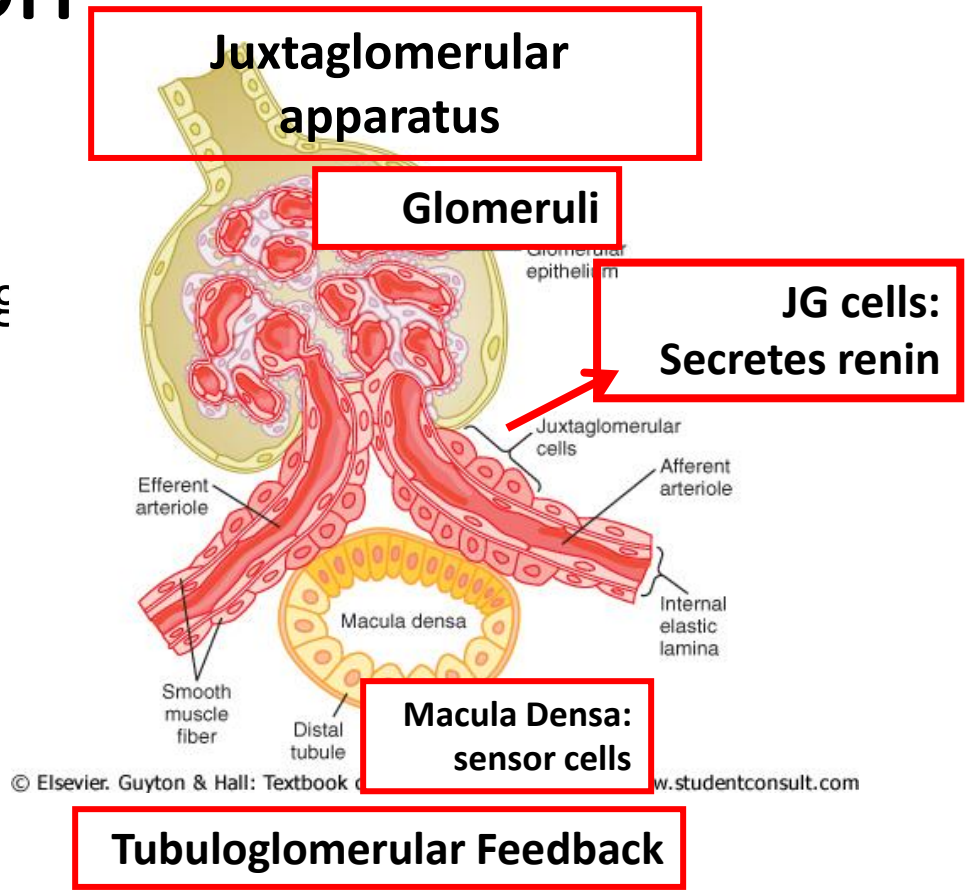
1- Perfusion Pressure

low perfusion in afferent arterioles stimulates renin secretion while hig perfusion inhibits renin secretion.

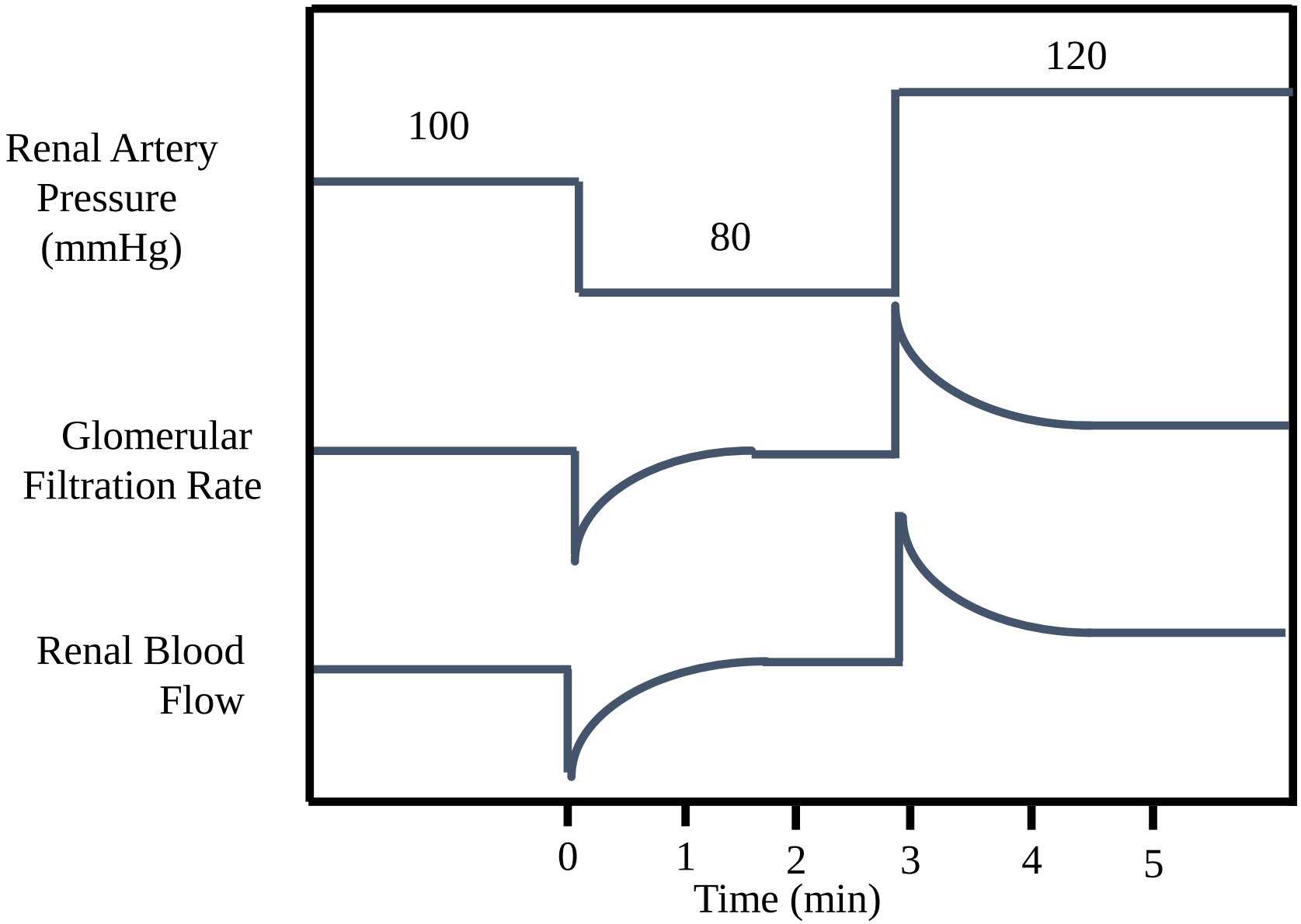
2-Sympathetic nerve activity

Activation of the sympathetic nerve fibers in the afferent arterioles increases renin secretion.

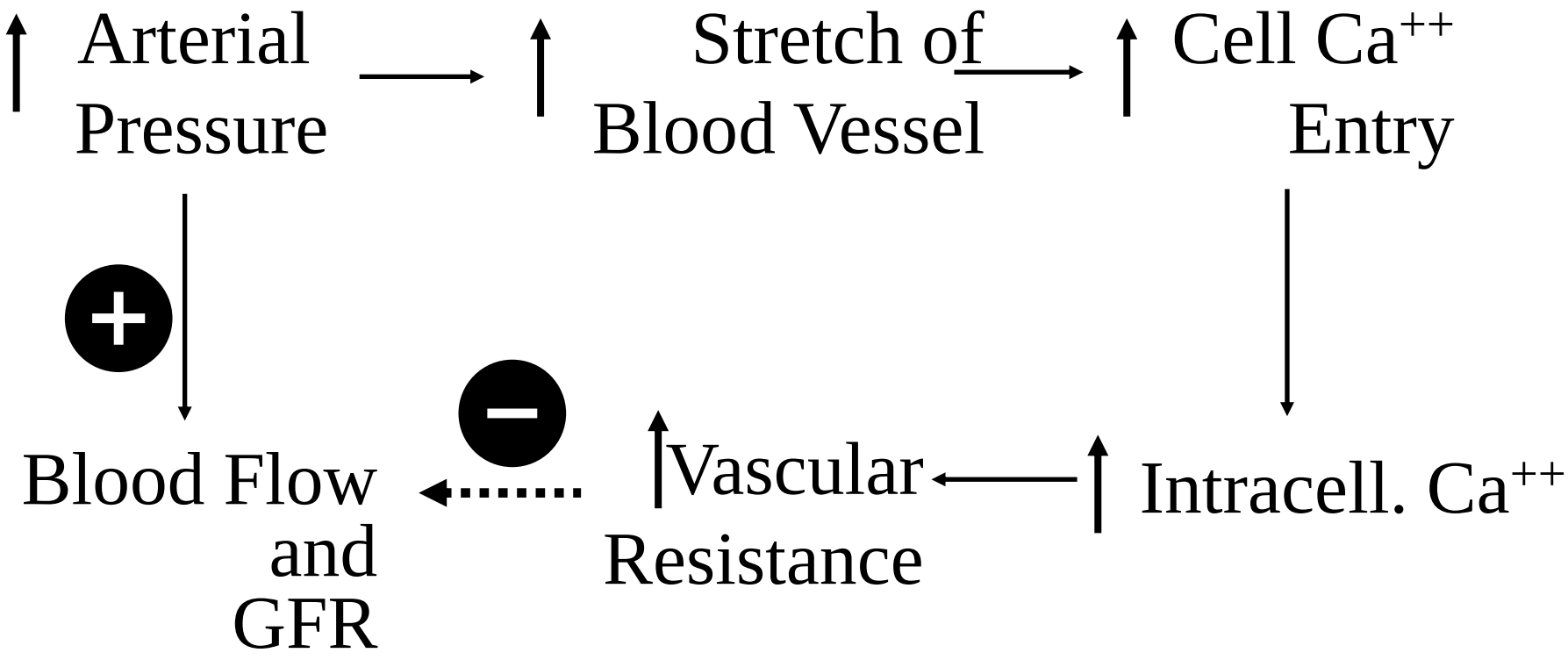
3- NaCl delivery to macula densa: When NaCl is decreased, Renin secretion is stimulated and vice versa. (**Tubuloglomerular Feedback)**



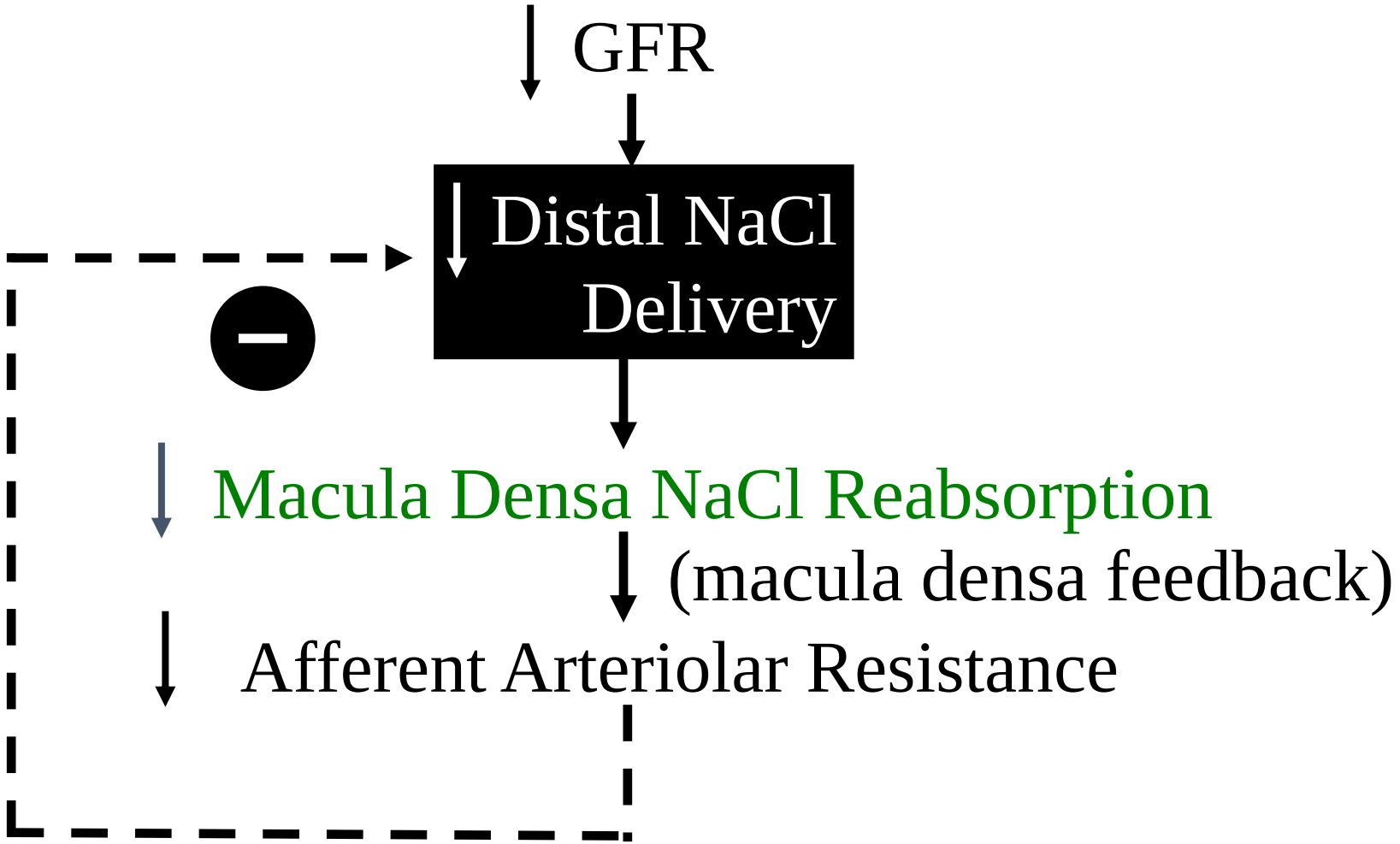
Renal Autoregulation



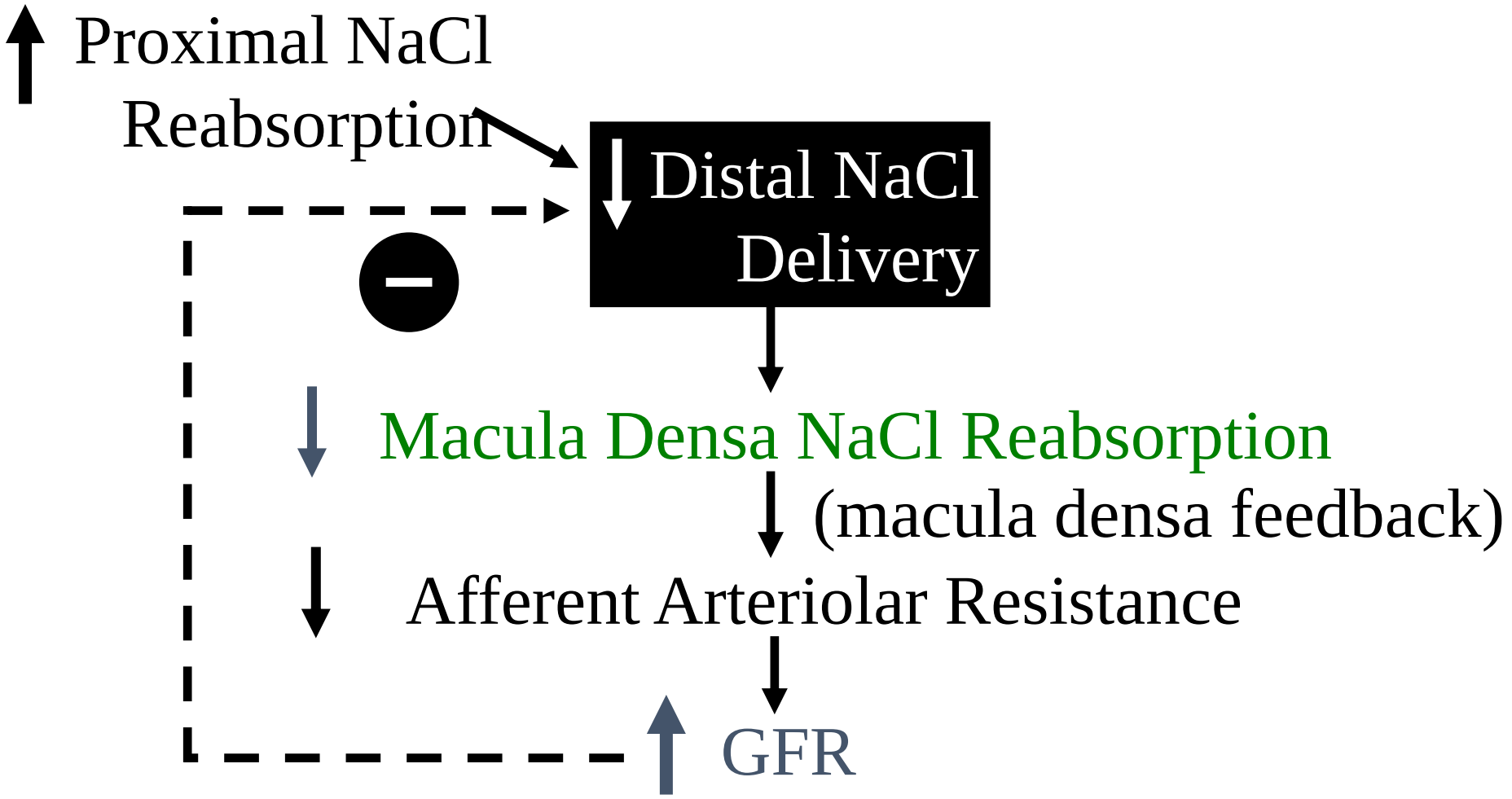
Myogenic Mechanism



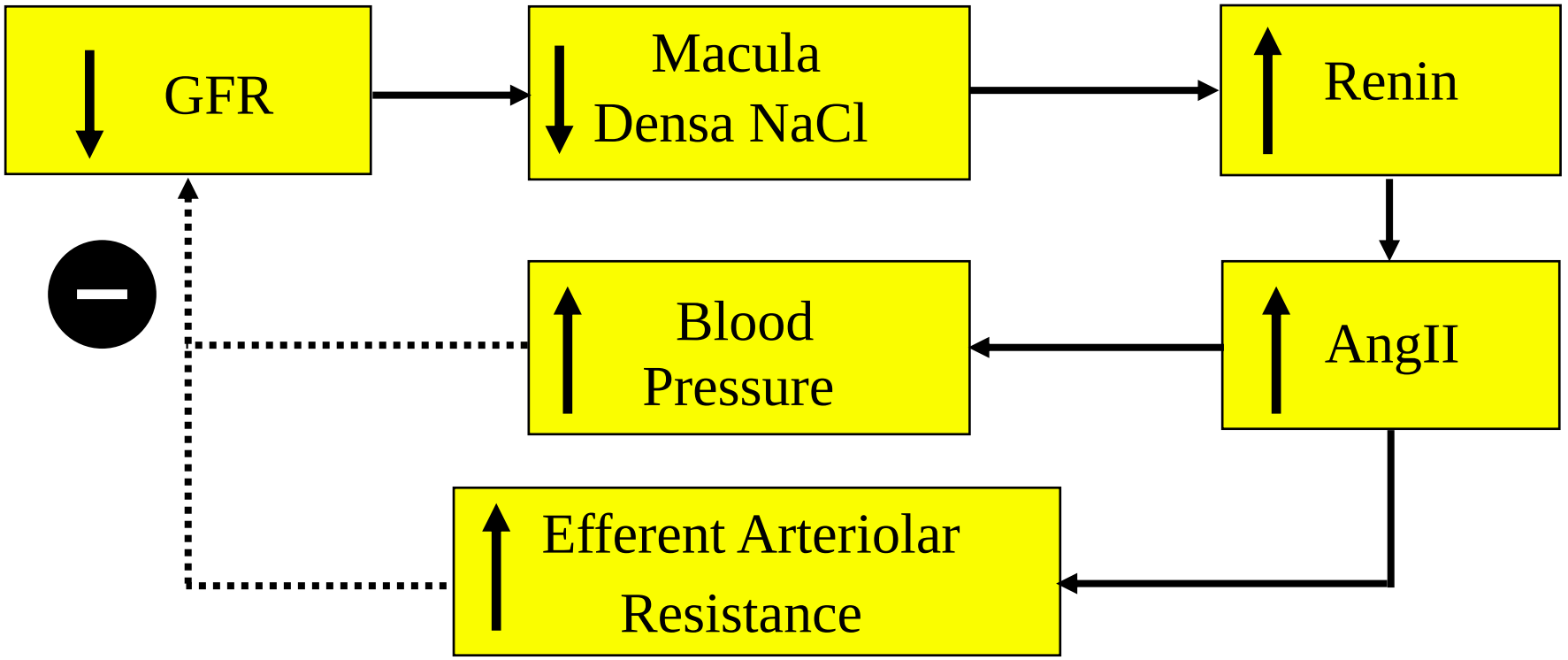
Macula Densa Feedback



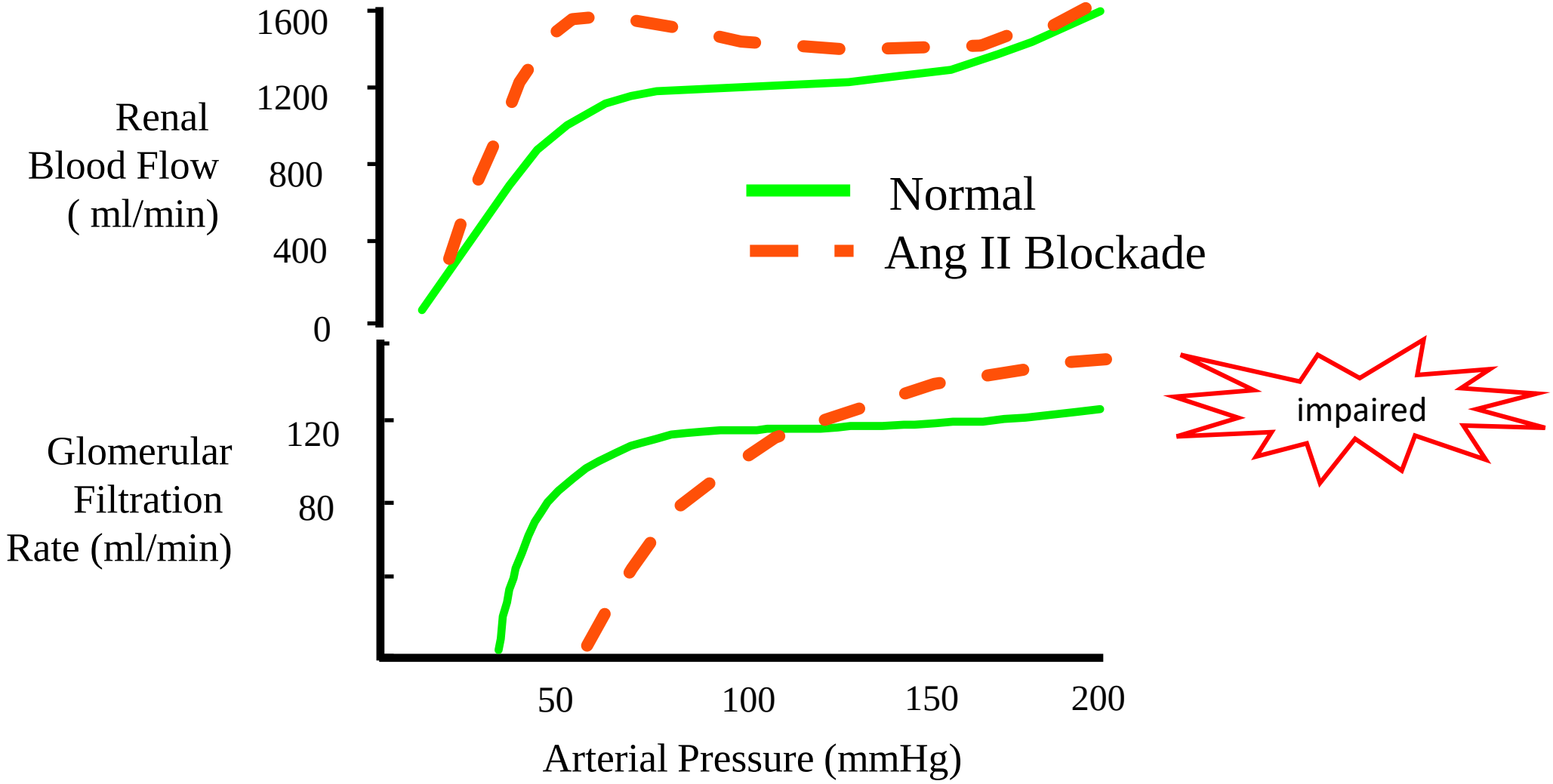
Macula Densa Feedback



Regulation of GFR by Ang II



Ang II Blockade Impairs GFR Autoregulation



Macula densa feedback mechanism for regulating GFR

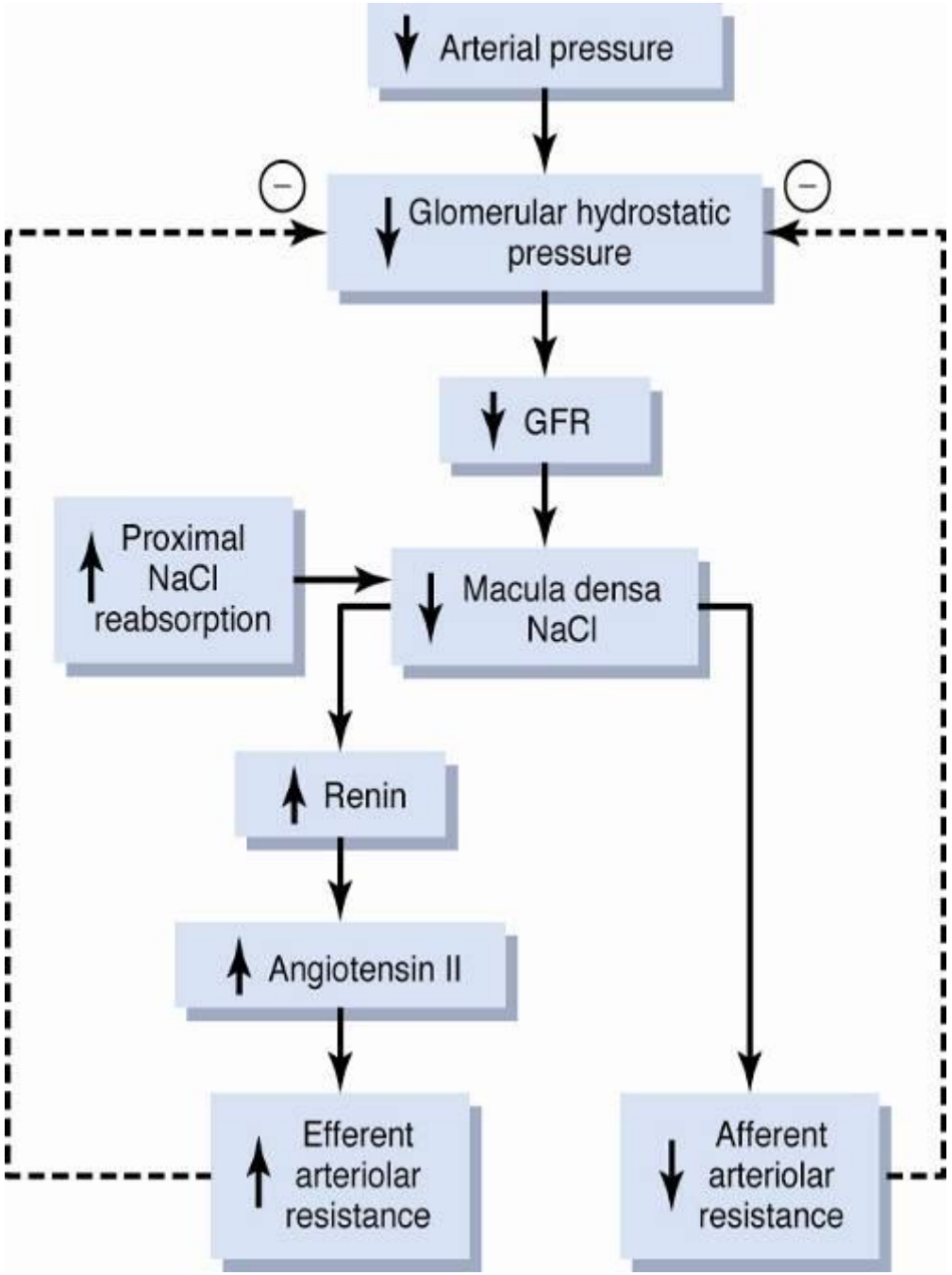
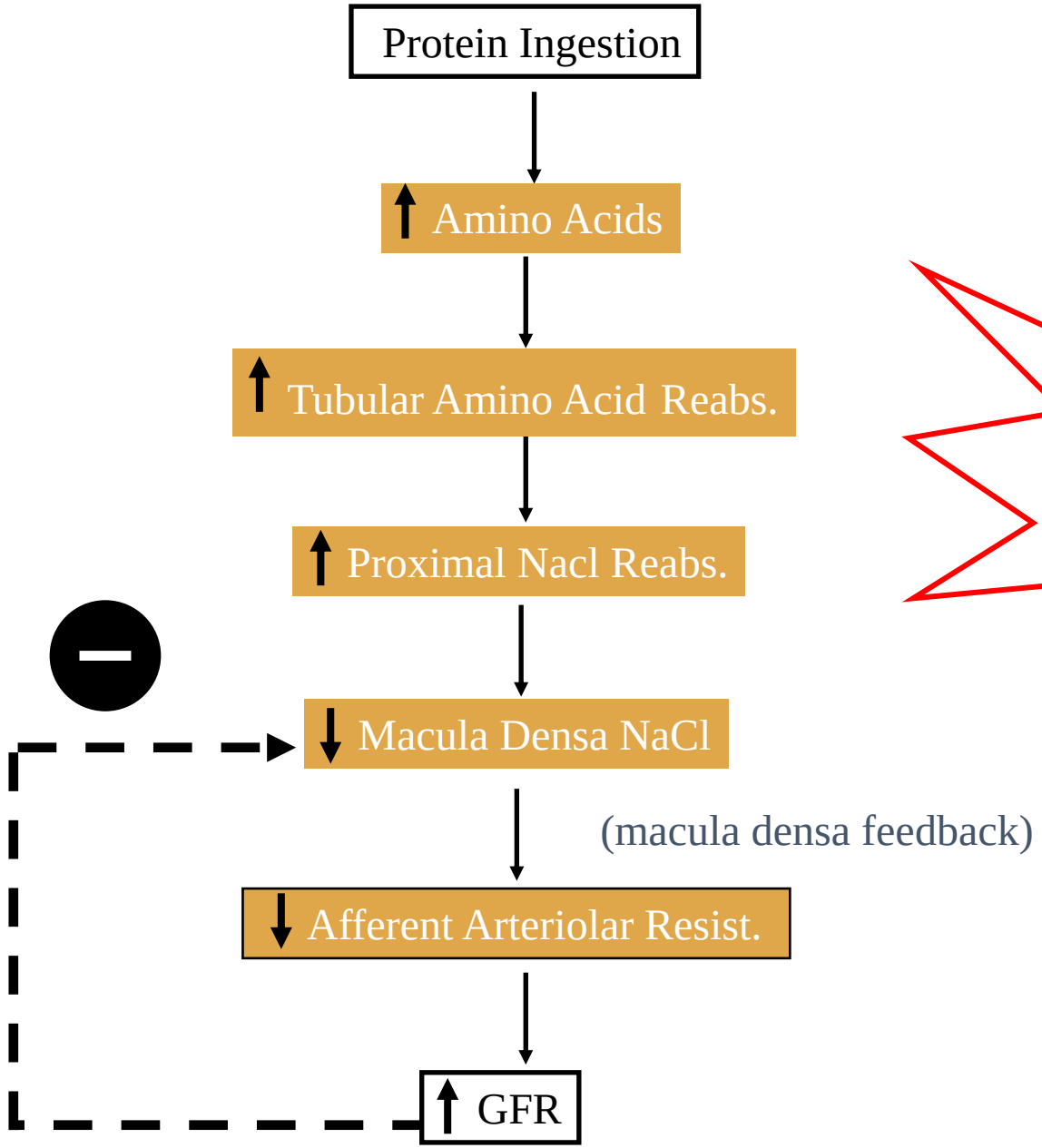


Figure 26-19

Other Factors That Influence GFR

- Fever, pyrogens: increase GFR
- Glucorticoids: increase GFR
- Aging: decreases GFR 10% / decade after 40 yrs
- Hyperglycemia: increases GFR (diabetes mellitus)
- Dietary protein: high protein increases GFR
  low protein decreases GFR



You should know this better when you take Reabsorption next lectures!

Importance of Autoregulation

Arterial Pressure	GFR	Reabsorption	Urine Volume
IF Poor Autoregulation + no change in tubular reabsorption			
100	125	124	1.0
120	150	124	26.0 = 37.4 L/day!
IF Good Autoregulation + no change in tubular reabsorption			
120	130	124	5.0
IF Good Autoregulation+adaptive increase in tubular reabsorption			
120	130	128.8	1.2

No way!

Perfect!